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Iwane

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(54) **SEMICONDUCTOR DEVICE AND METHOD FOR MANUFACTURING SAME**

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H01L 23/495 (2006.01)

(52) **U.S. Cl.**
USPC **257/668**; 257/666; 257/686; 257/698; 257/789; 438/123; 438/126

(58) **Field of Classification Search**
USPC 257/668, 666, 686, 698, 789, E23.01, 257/E21.506; 438/123, 126
See application file for complete search history.

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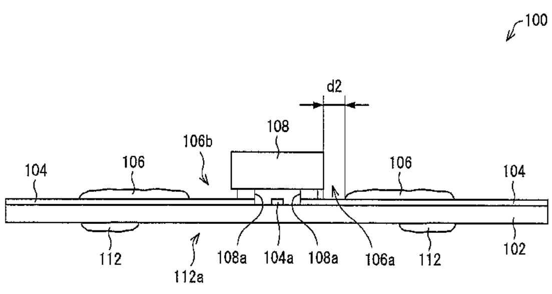
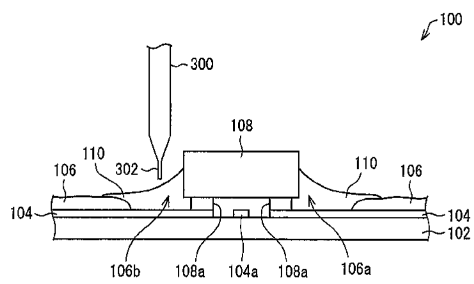
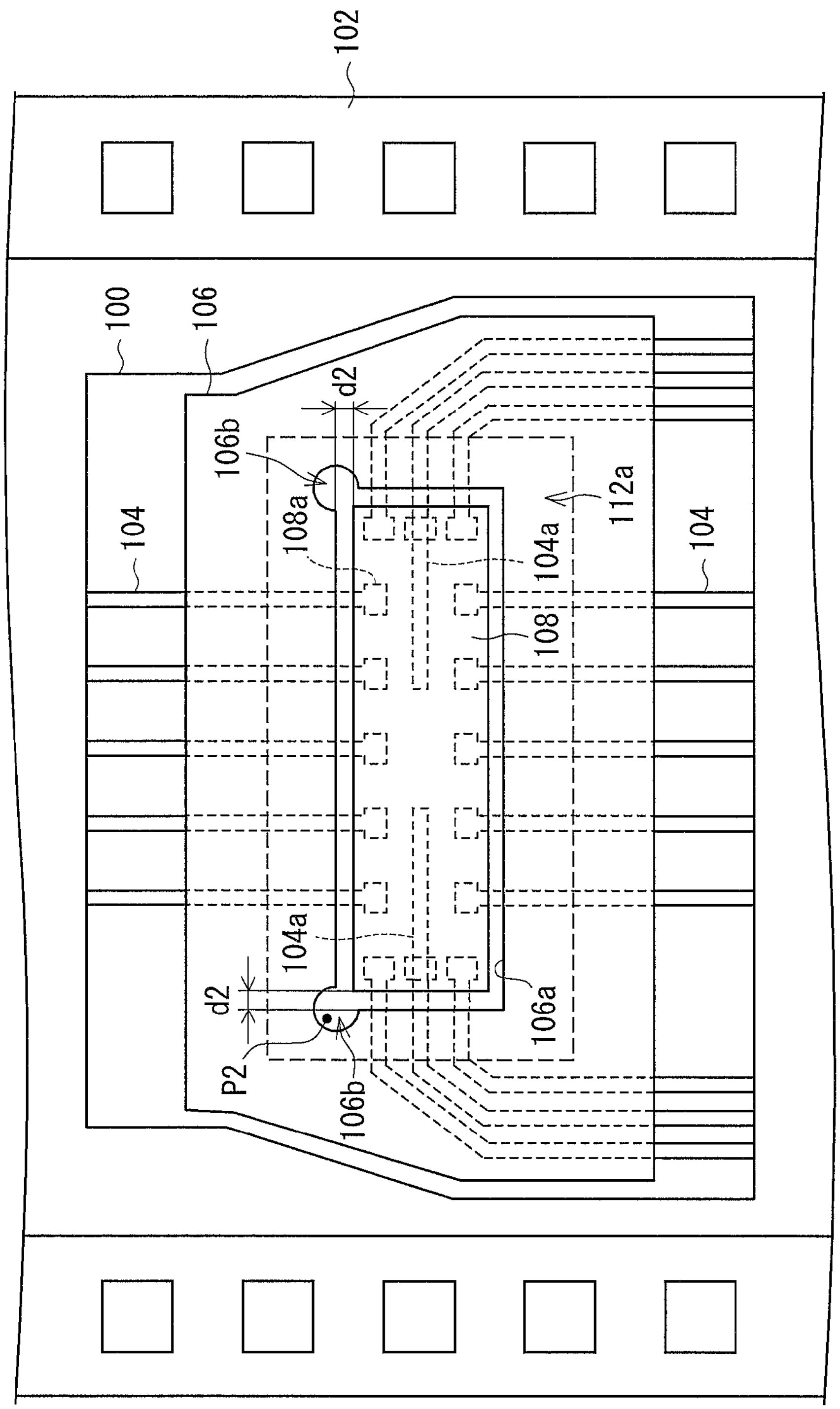
(57) **ABSTRACT**

A semiconductor device includes (i) a tape base material, (ii) a wiring pattern, (iii) a semiconductor element which is electrically connected with the wiring pattern, (iv) a top-side insulating protective film which covers a top surface of the tape base material and has an top-side opening section provided in a region where the top-side insulating protective film faces the semiconductor element, and (v) a reverse-side insulating protective film which covers a reverse surface of the tape base material and has a reverse-side opening section provided on a reverse side below the top-side opening section. The top-side insulating protective film has a protruding opening section extending outwardly from the region. An opening of the reverse-side opening section is 1.00 time to 8.50 times larger in an area than the region.

7 Claims, 7 Drawing Sheets



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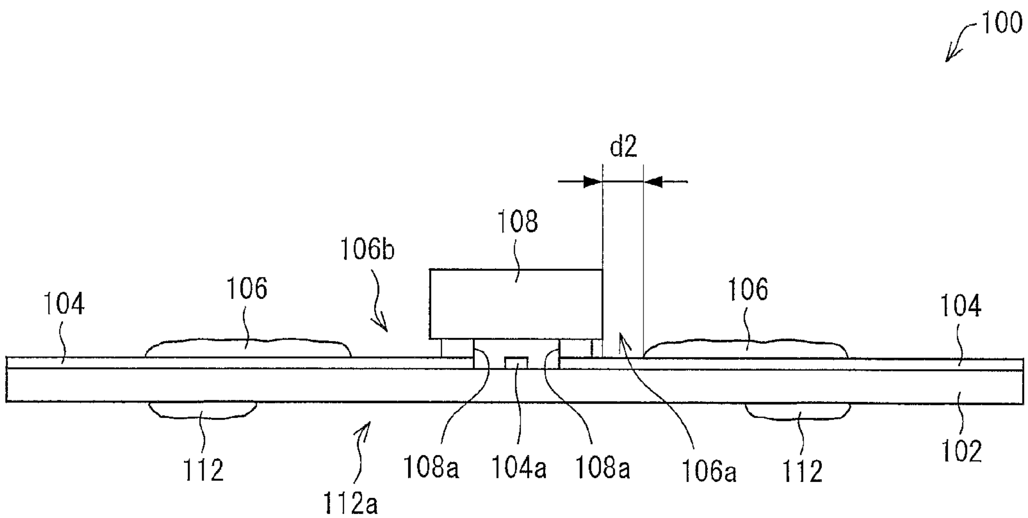
F I G. 2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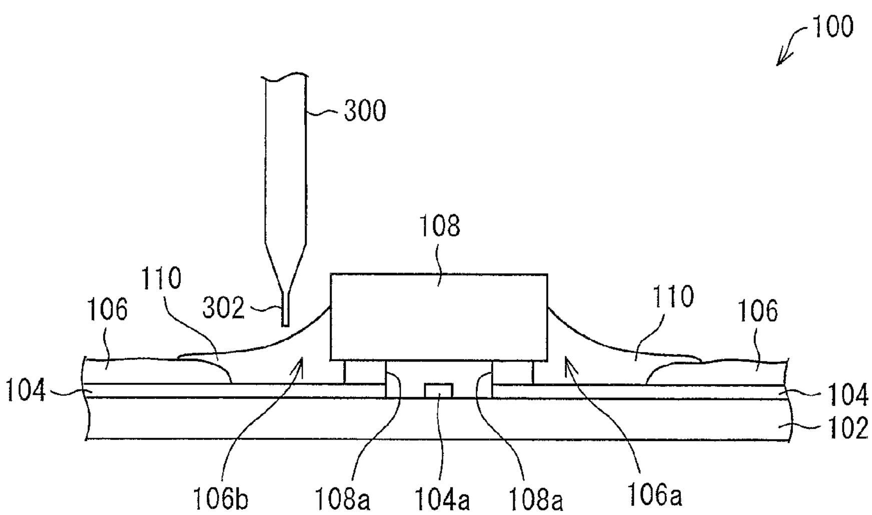
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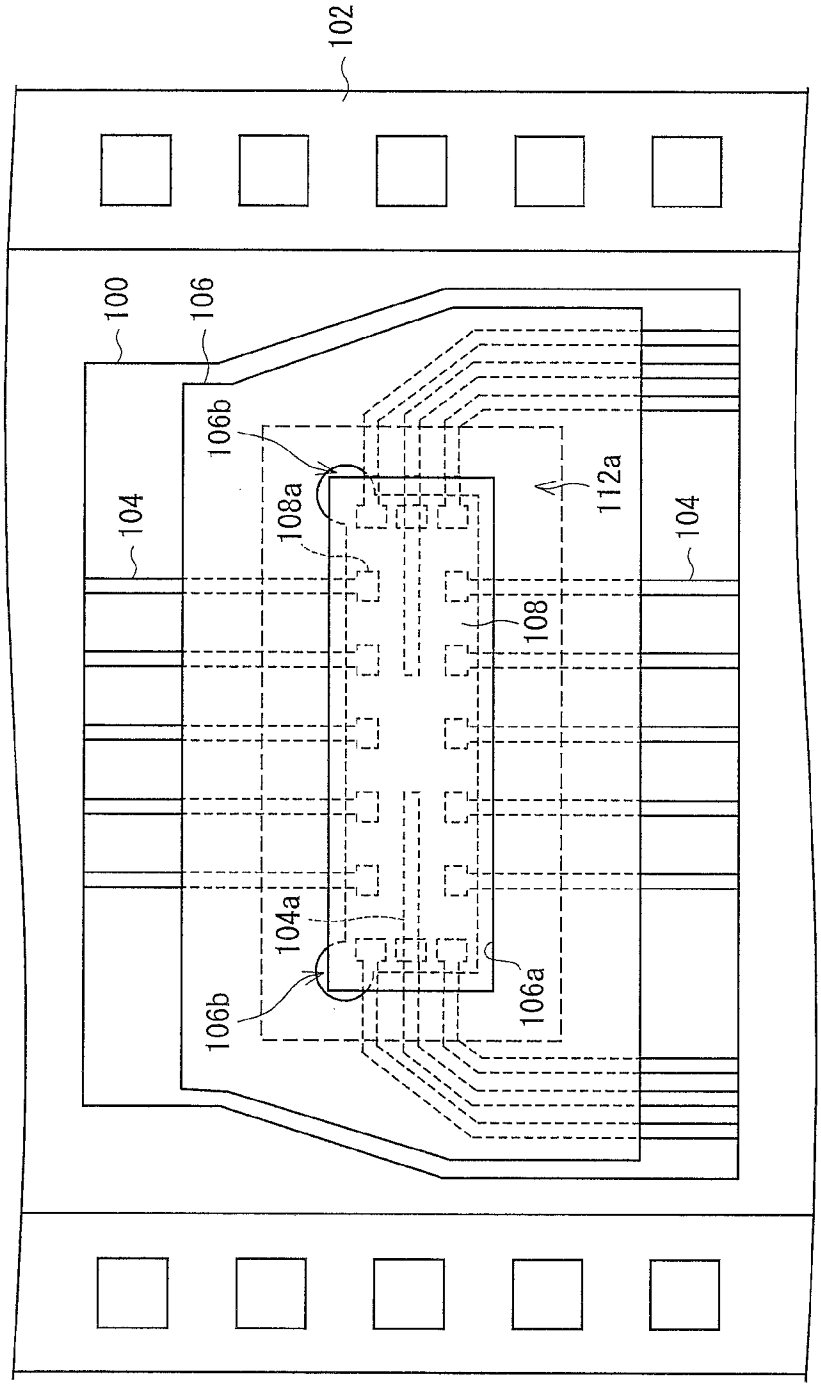

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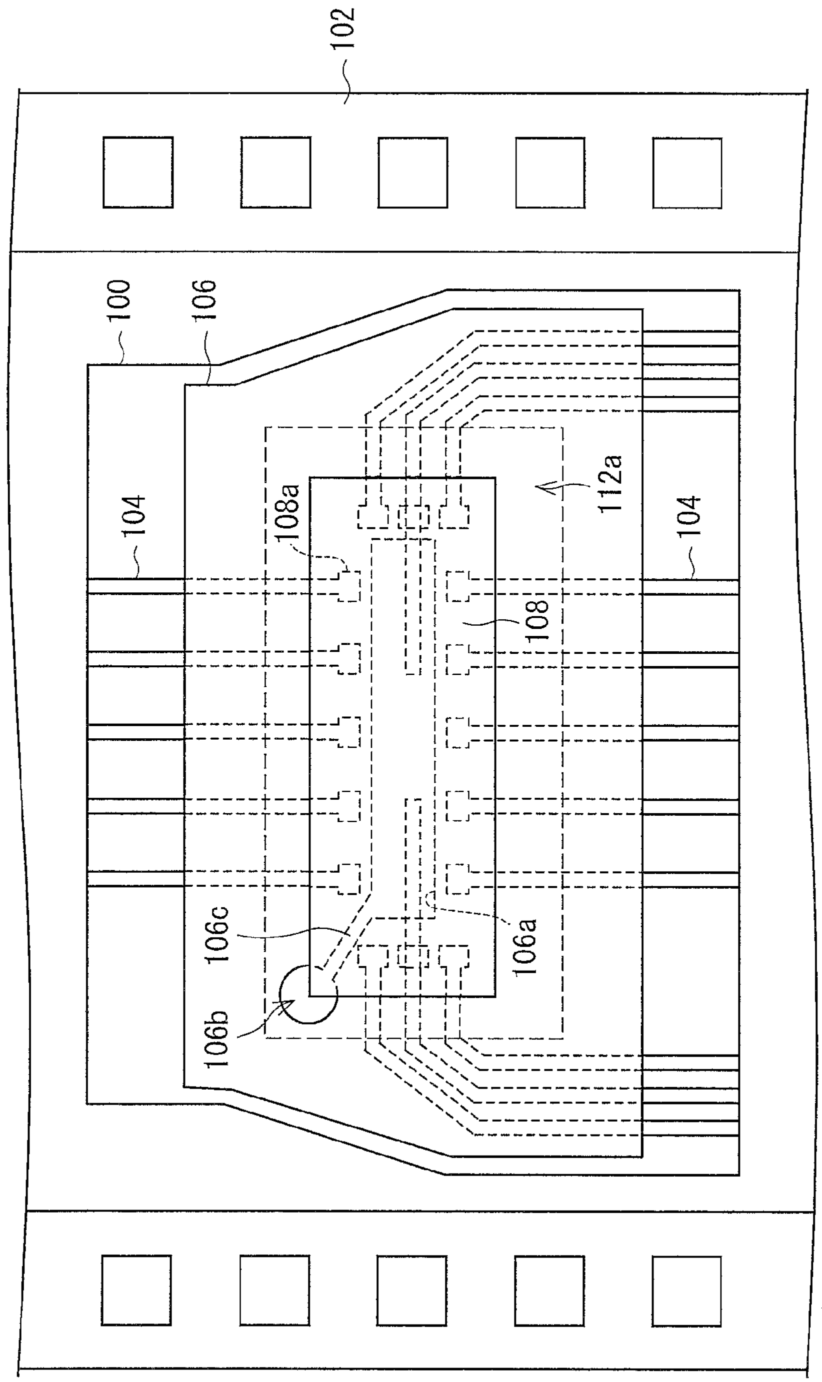
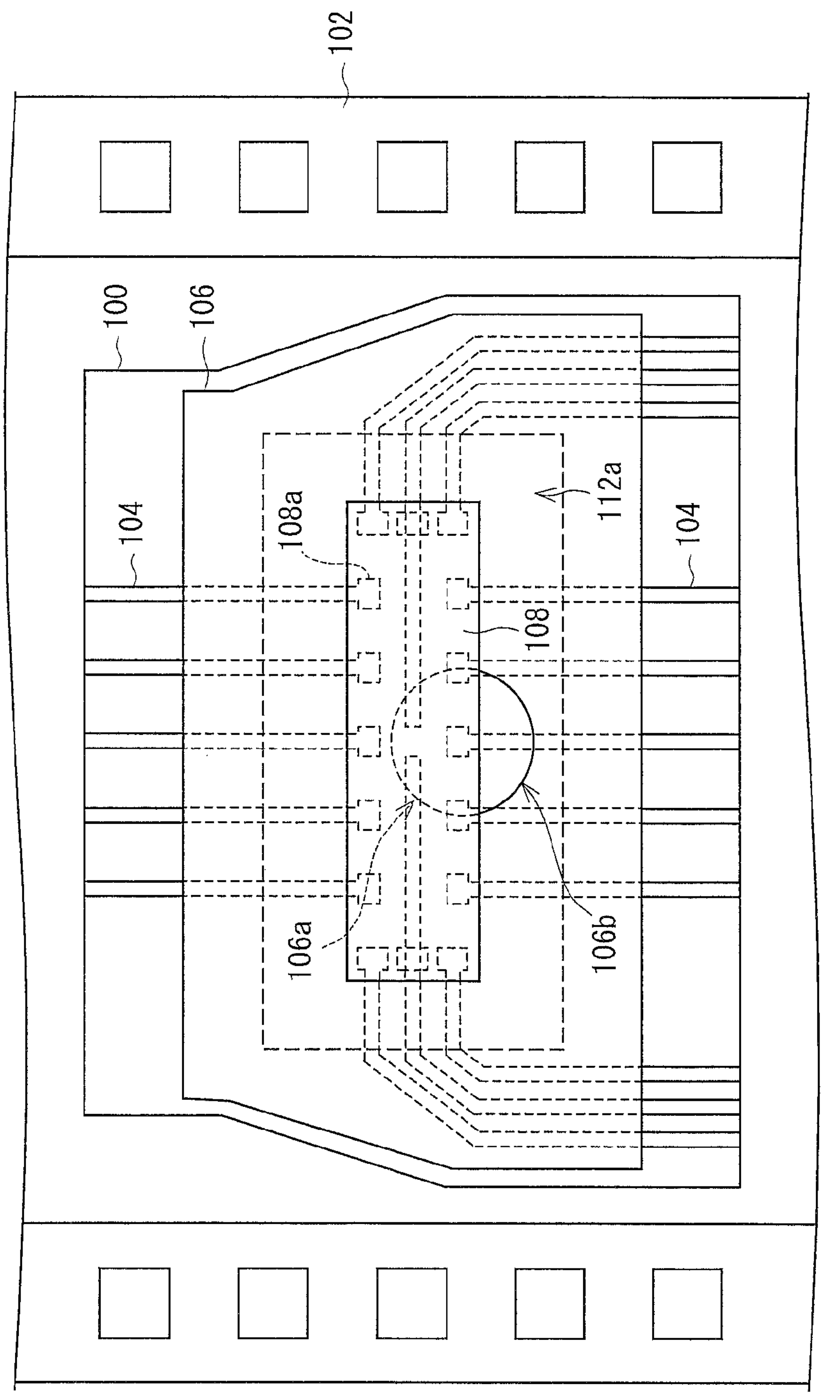


FIG. 5



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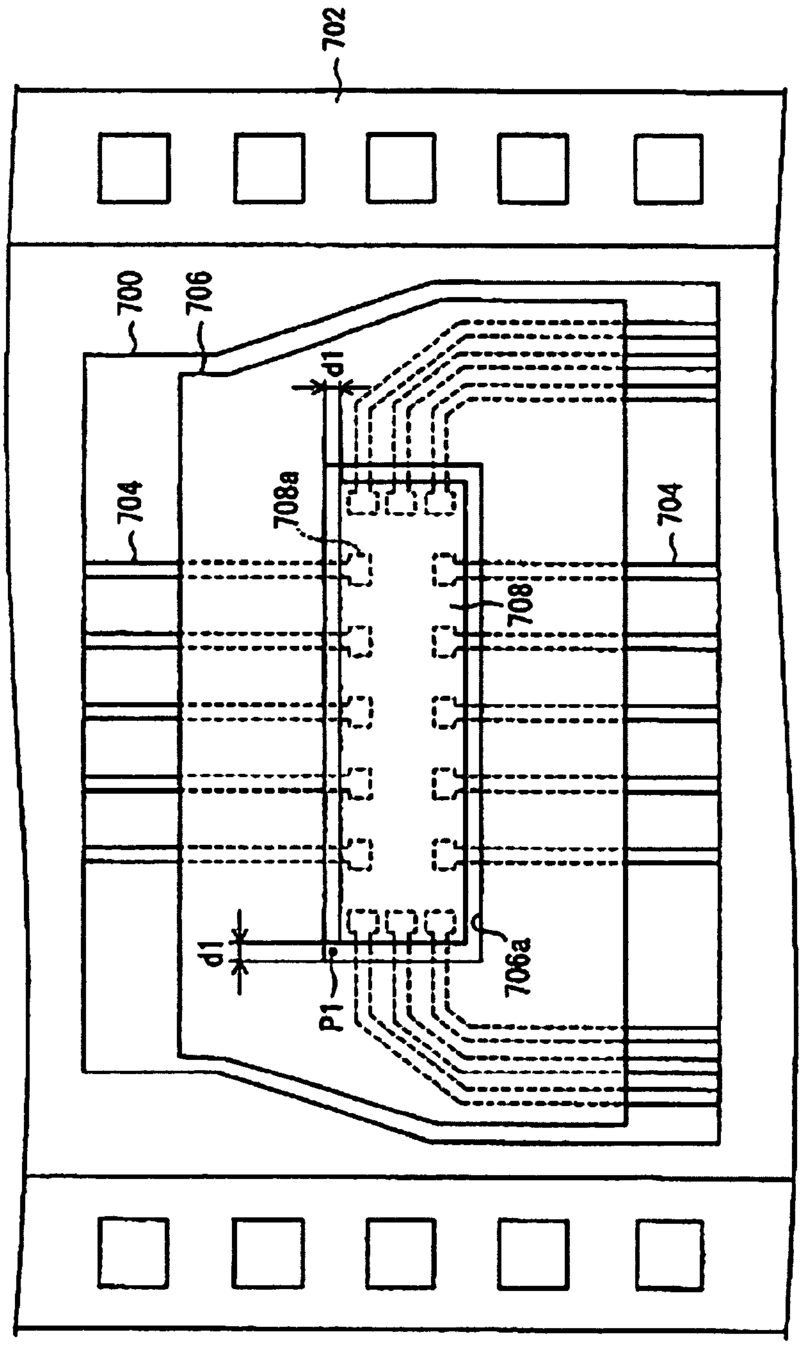


Background Art

FIG. 7

FIG. 8

Background Art

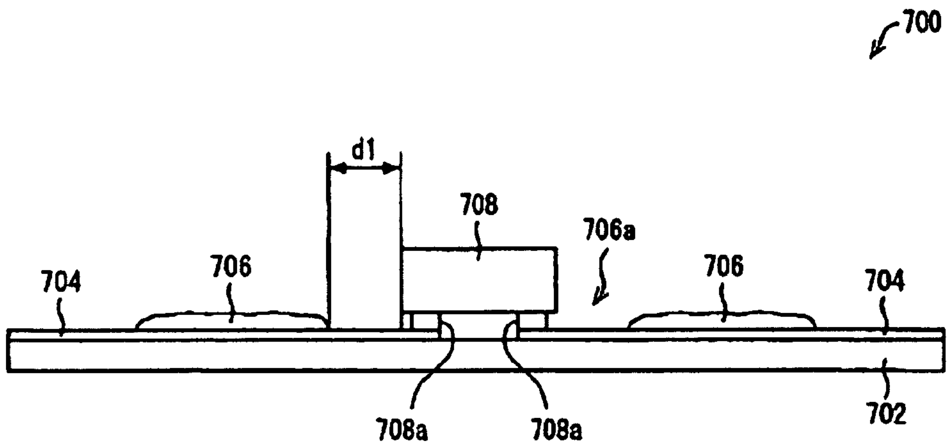
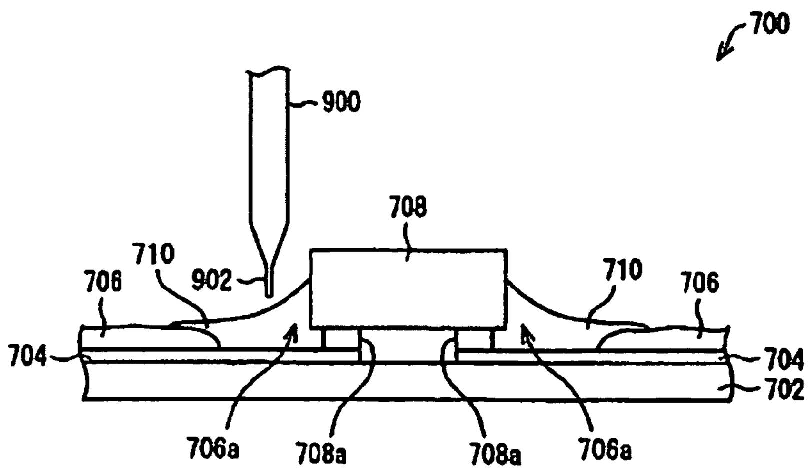


FIG. 9

Background Art



SEMICONDUCTOR DEVICE AND METHOD FOR MANUFACTURING SAME

This Nonprovisional application claims priority under 35 U.S.C. §119(a) on Patent Application No. 2011-037573 filed in Japan on Feb. 23, 2011, the entire contents of which are hereby incorporated by reference.

TECHNICAL FIELD

The present invention relates to a tape carrier type semiconductor device and a method for manufacturing the same.

BACKGROUND ART

Recently, many manufacturing processes of semiconductor devices adopt an art of sealing electronic components on a substrate with a resin, for the purpose of more securely fixing the electronic components (mainly semiconductor elements or the like) provided on the substrate. In the manufacturing processes adopting the art of sealing, it is desirable to more efficiently seal the electronic components with the resins, in order to attain higher quality of the semiconductor devices, lower manufacturing cost, shorter manufacturing periods, and the like.

Various arts of improving the sealing efficiencies have been disclosed in relation with the art of sealing the electronic component on the substrate with the resin.

For example, Patent Literature 1 describes an art in which a fence larger than a bear chip is provided around a region to which the bear chip is to be provided on a wiring board, in order to prevent a resin from widely spreading out of the region when the bear chip on the wiring board is sealed with the resin.

Patent Literature 2 describes an art in which a solder resist section has a trench part for impounding therein a liquid resin so as to prevent, if more than a required amount of the liquid resin is fed, the liquid resin from overflowing to a substrate.

Patent Literature 3 describes an art in which a gap (clearance) between (i) each side of an outer shape of an IC chip and (ii) a peripheral part of an opening in an insulating protective film is set to 0.2 mm to 0.5 mm.

Patent Literature 4 describes an art of preventing an underfilling resin from being easily exfoliated from a flexible substrate when the flexible substrate is bent. According to the art of Patent Literature 4, (i) an opening section of an insulating protective film is provided in a region outer than a region where an electronic component is mounted, i.e., a region where an applied force is concentrated most, and (ii) the underfilling resin is firmly adhered to the flexible substrate in the opening section.

(Conventional Semiconductor Device)

The following describes a conventional semiconductor device which employs the art in which the electronic component provided on the substrate is sealed with the resin. FIG. **7** is a view showing a top side of a conventional semiconductor device **700**. FIG. **8** is a view showing a lateral cross section of the conventional semiconductor device **700**.

As shown in FIGS. **7** and **8**, the semiconductor device **700** includes a substrate **702**, a wiring pattern **704**, an insulating protective film **706**, and a semiconductor element **708**. Each of FIGS. **7** and **8** shows the semiconductor device **700** for which a filling agent **710** (which is later discussed in FIG. **9**) has not been applied yet.

The substrate **702** is a so-called flexible substrate, which is flexible. The wiring pattern **704** is provided on a surface of the substrate **702**. The surface of the substrate **702** on which the wiring pattern **704** is provided is covered with the insulating protective film **706** which has an insulting property.

The insulting protective film **706** has an opening section **706***a* provided in a region where the semiconductor element **708** is provided. In this conventional example, the semiconductor element **708** has a rectangular outer shape. Accordingly, the opening section **706***a* has a rectangular shape substantially same as the outer shape of the semiconductor element **708**.

The opening section **706***a* has a size greater than the semiconductor element **708**. Specifically, each side of the rectangular shape of the opening part **706***a* is longer in length than a corresponding side of the rectangular shape of the semiconductor element **708** by 0.4 mm to 1.0 mm. As such, a space d**1** between a peripheral part of the opening section **706***a* and a peripheral part of the semiconductor element **708** is set to 0.2 mm to 0.5 mm.

The semiconductor element **708** is provided on the surface of the substrate **702** within the opening section **706***a*, and is connected with the wiring pattern **704** via an electrode **708***a* of the semiconductor element **708**.

(Feeding of with Filling Agent **710**)

Further, in the conventional semiconductor device **700** shown in FIGS. **7** and **8**, the filling agent **710** (see FIG. **9**) is fed so as to attain the aforementioned objective. FIG. **9** is a view showing, in magnification, the lateral cross section of the conventional semiconductor device **700** for which the filling agent **710** has already been fed. Specifically, after mounting of the semiconductor element **708** on the substrate **702**, the filling agent **710** is fed to an inside of the opening section **706***a* provided on the substrate **702**.

A dispenser **900** is used for feeding the filling agent **710**. The dispenser **900** is loaded with a sufficient amount of the filling agent **710** in advance. The feeding of the filling agent **710** is carried out by positioning a nozzle section **902** of the dispenser **900** at a given location (e.g., a location P**1** shown in FIG. **7**) in the space between the opening section **706***a* and the semiconductor element **708** at first. Then, the dispenser **900** is moved along the space while the filling agent **710** is being discharged from a tip of the nozzle section **902**, so as to feed the filling agent **710** to the inside of the opening section **706***a*. By this, the filling agent **710** is fed in the entire opening section **706***a*.

CITATION LIST

Patent Literatures

Patent Literature 1
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Patent Literature 2
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Patent Literature 4
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SUMMARY OF INVENTION

Technical Problem

However, the aforementioned conventional art cannot suitably feed a resin in a space between the semiconductor element and the substrate without causing a failure such as failing to fill the space, filling with an air cell, or the like failure. For example, in the conventional art, when a material of an insulating protective film is provided on the substrate and cured, the material of the insulating protective film is shrunk by the curing. In the conventional art, because the insulating protective film is provided only on one side surface of the substrate, the substrate is curled or waved as the insulating protective film is shrunk by the curing. A space between the semiconductor element and the substrate to which the resin is fed is as small as 10 μm to 30 μm. On this account, if the substrate is curled or waved, the resin cannot be appropriately fed in the entire space. As a result, the failure such as failing to fill the space, filling with an air cell, or the like failure is caused in the space between the semiconductor element and the substrate. Such failure causes deterioration in reliability of a semiconductor device, such as a decrease in strength of adhesion between the semiconductor element and the substrate, or the like.

An object of the present invention is to provide a semiconductor device and a method for manufacturing the same, in each of which it is possible that a filling agent fills a gap between a semiconductor element and a tape base material without causing a failure such as failing to fill the space, filling with an air cell, or the like failure.

Solution to Problem

In order to attain the object, a semiconductor device of the present invention is a semiconductor device, which is a tape carrier semiconductor device including a semiconductor element provided on a top surface of a tape base material so as to be electrically connected with a wiring pattern provided on the top surface of the tape base material, the semiconductor device including: a top-side insulating protective film covering the top surface of the tape base material; and a reverse-side insulating protective film covering a reverse surface of the tape base material, the top-side insulating protective film having (i) a top-side opening section opening in at least a part of a region where the top surface of the tape base material faces the semiconductor element and (ii) a protruding opening section outwardly extending from the region, the reverse-side insulating protective film having a reverse-side opening section opening on a reverse side below the top-side opening section, an opening of the reverse-side opening section being 1.00 time to 8.50 time larger in an area than the region where the top surface of the tape base material faces the semiconductor element, and a filling agent filling a gap between the semiconductor element and the tape base material in the region where the top surface of the tape base material faces the semiconductor element.

With the arrangement, the insulating protective films shrink on the respective top and reverse sides of the tape base material when they are cured. As such, it is possible to offset curling caused on a top surface side of the tape base material with curling caused on a reverse surface side of the tape base material. This is very advantageous to manufacturing of the tape carrier semiconductor device. That is, in the manufacturing of the tape carrier semiconductor device, in which (i) the semiconductor element is mounted, after formation of the insulating protective films, in the top-side opening section (the inner lead section) covered with no insulating protective film, and then (ii) the filling agent is fed in between the semiconductor element and the top-side opening section, that is, in which the top-side opening section for mounting of the semiconductor element is necessary, it is required to prevent the tape base material from being curled in a region where the top-side opening section is provided. However, if the insulating protective film is formed on the entire reverse surface of the tape base material without having the reverse-side opening section, then the tape base material is curled one-sidedly in the top-side opening section. In view of this, the reverse-side opening sections are provided in the arrangement, so as to enable avoiding such a situation. As a result, it becomes possible that the filling agent is suitably fed to the entire space between the semiconductor element and the tape base material.

Further, the positioning mark (of a cruciform, an L-shaped form, etc.), in accordance with which the semiconductor element is positioned, is provided on the top surface of the tape base material in the space part between the semiconductor element and the peripheral part of the top-side opening section. However, if the reverse surface of the tape base material is covered with the reverse insulting protective film in a region on the reverse side below the positioning mark, then a problem is caused to positioning of the semiconductor element. As a countermeasure to this, it is arranged such that the opening of the reverse-side opening section is set to a size at least 1.00 time larger than the area of the region where the top surface of the tape base material faces the semiconductor element. Because this enables avoiding a risk that the reverse surface of the tape base material is covered with the reverse-side insulating protective film in the region on the reverse side below the positioning mark, it is possible to perform the positioning of the semiconductor element without causing the problem.

Also, because the opening of the reverse-side opening section is thus 1.00 time to 8.50 times larger in the area than the region where the tape base material faces the semiconductor element, it is possible to (i) avoid interference that, when a reverse side of the semiconductor device is fixed, a device jig and the reverse-side insulating protective film interfere with each other and (ii) prevent the curling of the tape base material.

A method of the present invention for manufacturing a semiconductor device is a method for manufacturing a tape carrier semiconductor device including a semiconductor element provided on a top surface of a tape base material so as to be electrically connected with a wiring pattern provided on the top surface of the tape base material, the method including the steps of: forming a top-side insulating protective film covering the top surface of the tape base material, wherein the step of forming the top-side insulating protective film forms the top-side insulating protective film which has (i) a top-side opening section opening in at least a part of a region where the top surface of the tape base material faces the semiconductor element and (ii) a protruding opening section outwardly extending from the region; and forming a reverse-side insulating protective film covering a reverse surface of the tape base material, wherein the step of forming the reverse insulting protective film forms the reverse-side insulating protective film which has a reverse-side opening section opening in a reverse side of the top-side opening section, an opening of the reverse-side opening section being 1.00 time to 8.50 times larger in an area than the region where the top surface of the tape base material faces the semiconductor element; and feeding a filling agent through the protruding opening section to the region where the top surface of the tape base material faces the semiconductor element.

The arrangement can bring about, in manufacturing of the semiconductor device, an effect similar to the effect brought about by the semiconductor device of the present invention as early described.

Advantageous Effects of Invention

In each of a semiconductor device of the present invention and a method of the present invention for manufacturing the same, it is possible that a filling agent fills a gap between a semiconductor element and a tape base material without causing a failure such as non-filling, formation of an air bubble, or the like.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a view showing a top side of a semiconductor device in accordance with Embodiment 1.

FIG. **2** is a view showing a lateral cross section of the semiconductor device in accordance with Embodiment 1.

FIG. **3** is a view showing, in an enlarged size, the lateral cross section of the semiconductor device in accordance with Embodiment 1.

FIG. **4** is a view showing a top side of a semiconductor device in accordance with Embodiment 2.

FIG. **5** is a view showing a top side of a semiconductor device in accordance with Embodiment 3.

FIG. **6** is a view showing a top side of a semiconductor device in accordance with Embodiment 4.

FIG. **7** is a view showing a top side of a conventional semiconductor device.

FIG. **8** is a view showing a lateral cross section of the conventional semiconductor device.

FIG. **9** is a view showing, in an enlarged size, the lateral cross section of the conventional semiconductor device.

DESCRIPTION OF EMBODIMENTS

Embodiments 1 to 4 of the present inventions are described below with reference to the figures.

Embodiment 1

FIG. **1** is a view showing a top side of a semiconductor device **100** in accordance with Embodiment 1 of the present invention. FIG. **2** is a view showing a lateral cross section of the semiconductor device **100** in accordance with Embodiment 1.

FIG. **1** shows only one semiconductor device **100**. However, in reality, two or more semiconductor devices **100** are arranged at regular intervals on a tape base material **102** in a direction in which the tape base material **102** is extended. One semiconductor device **100** out of the two or more semiconductor devices **100** is hereinafter described. The rest of the two or more semiconductor devices **100** are similar to the semiconductor device **100** described below, and their explanation is omitted.

<Arrangement of Semiconductor Device>

The semiconductor device **100** of Embodiment 1 is a tape carrier semiconductor device and includes the tape base material **102**, a wiring pattern **104**, a top-side insulating protective film **106**, a semiconductor element **108**, a filling layer **110**, and a reverse-side insulating protective film **112**.

Tape Base Material **102**

The tape base material **102** is a so-called flexible substrate having flexibility. An insulant having flexibility is used as a material of the tape base material **102**. A material such as a polyimide film having a tape-like shape of a thickness of 12 μm to 50 μm or the like can be employed as the tape base material **102**, for example.

Semiconductor Element **108**

The semiconductor element **108** is an element provided on the tape base material **102**. As shown in FIG. **3**, (i) the semiconductor element **108** has an electrode **108*a*** provided on a surface facing the tape base material **102**, and (ii) the electrode **108*a*** is electrically connected, by use of a metal bump or the like, with a terminal of the wiring pattern **104** which is provided on the tape base material **102**. As the semiconductor element **108**, a conventional and well-known semiconductor element can be used. For example, a display driver can be used as the semiconductor element **108** of the present invention, in a case where the semiconductor device **100** is used to serve as driving means of an image display device.

Wiring Pattern **104**

The wiring pattern **104** is provided on the surface of the tape base material **102**. The wiring pattern **104** is provided for electrically connecting the semiconductor element **108** with an external device (which is not shown). In a case where the display driver is used as the semiconductor element **108**, as described above, the wiring pattern **104** provided on the tape base material **102** can electrically connect the display driver with display means corresponding to the external device.

A part of the wiring pattern **104** is covered with the top-side insulating protective film **106**, as later described. Specifically, the wiring pattern **104** is covered with the top-side insulating protective film **106**, except for (i) a part to which the electrode **108*a*** of the semiconductor element **108** is electrically connected and (ii) a part near the part (i). The parts (i) and (ii) of the wiring pattern **104** thus covered with no top-side insulating protective film **106** (i.e., exposed parts) are sometimes referred to as inner lead sections of the wiring pattern **104**.

Further, the following parts (iii) and (iv) of the wiring pattern **104** are covered with no top-side insulating protective film **106**, (iii) an end part for connecting with an external terminal, which end part is provided on an side opposite to a side on which the semiconductor element **108** is provided, and (iv) a part near the end part (iii). The parts (iii) and (iv) of the wiring pattern **104** thus covered with no top-side insulating protective film **106** (i.e., exposed parts) are sometimes referred to as outer lead sections of the wiring pattern **104**.

Extending Section **104*a***

A part of the inner lead sections of the wiring pattern **104** has an extending section **104*a*** which extends inwardly from (i) a connection part of the part of the inner lead sections and the semiconductor element **108** toward (ii) a central part of the top-side opening section **106*a***. More specifically, the extending section **104*a*** extends from (i) a region to which the electrode **108*a*** of the semiconductor element **108** is located to approximately (ii) a center of the top-side opening section **106*a***.

The extending section **104*a*** thus provided makes it possible that the filling agent **110**, which is fed into the top-side opening section **106*a***, flows along the extending section **104*a*** to the entire top-side opening section **106*a***. That is, in the semiconductor device **100** of Embodiment 1, it is easy that the filling agent **110** flows to an inner part of the top-side opening section **106*a*** in a space between the semiconductor element **108** and the tape base material **102**. It follows that in the semiconductor device **100** of Embodiment 1, the filling agent **110** can more suitably fill the space between the semiconductor element **108** and the tape base material **102**.

In the semiconductor device **100** of Embodiment 1, the extending section **104*a*** has a line width of 0.05 mm to 0.20 mm. This is based on the following reason.

In the semiconductor device **100** of Embodiment 1, the extending section **104*a*** is used to serve also as a power supply line.

Because of this, if the line width of the extending section **104*a*** is thinner than 0.05 mm, then there is a risk that the extending section **104*a*** is burned by a voltage applied thereto, because the extending section **104*a*** is not tolerant against power caused in the extending section **104*a*** by the voltage.

On the other hand, if the line width of the extending section **104***a* is wider than 0.20 mm, then a surface area of the extending section **104***a* is increased to such a value that a reduction in a size of the semiconductor device **100** is hindered.

Moreover, if the line width of the extending section **104***a* is wider than 0.20 mm, then the surface area of the extending section **104***a* is increased, whereas an area of an exposed part of the tape base material **102** in the top-side opening section **106***a* is decreased. Generally, a filling agent which is used to seal a semiconductor element has a greater adhesiveness to an exposed part of a tape base material than to a surface of a wiring pattern.

On this account, such a larger surface area of the extending section **104***a* in the top-side opening section **106***a* leads to easy exfoliation of the filling agent **110**.

In essence, in the semiconductor device **100** of Embodiment 1, the extending section **104** is set to the line width of 0.05 mm to 0.20 mm which is the most suitable in view of (i) preventing of the burning of extending section **104***a* and (ii) improving an effect to prevent exfoliation of the filling agent **110**.

However, the extending section **104***a* is not limited to the line width of 0.05 mm to 0.20 mm. It may be set to a line width of thinner than 0.05 mm or a line width of wider than 0.20 mm.

The extending section **104***a* is not limited to the arrangement that one end of the extending section **104***a* is in contact with the electrode **108***a* and the other end of the extending section **104***a* is disconnected (see FIG. **1** and the like). The extending section **104***a* may be freely arranged, i.e., both of the ends of the extending section **104***a* may be in contact with the electrode **108***a*, or the like.

Top-Side Insulating Protective Film **106**

The top-side insulating protective film **106** covers a part of the top surface of the tape base material **102** on which the wiring pattern **104** is provided. The top-side insulating protective film **106** mainly has a role on preventing patterns in the wiring pattern **104** from being in contact with each other to be short-circuited, or the like. Accordingly, the top-side insulating protective film **106** is made from an insulating material.

The top-side insulating protective film **106** is a so-called solder resist. A material such as a melamine resin, an epoxy resin, a polyimide resin, etc. can be used as the top-side insulating protective film **106**, for example.

Further, the top-side insulating protective film **106** has the top-side opening section **106***a* that opens in a region where the top surface of the tape base material **102** faces the semiconductor element **108**.

Top-Side Opening Section **106***a*

In Embodiment 1, the top-side opening section **106***a* has a shape substantially similar to an outer shape of the semiconductor element **108**. Specifically, because the outer shape of the semiconductor element **108** has a rectangular shape (see FIG. **1**), the top-side opening section **106***a* has a rectangular shape substantially similar to the rectangular shape of the outer shape of the semiconductor element **108**.

The top-side opening section **106***a* is thus provided. With this, the inner lead sections of the wiring pattern **104** are exposed as early described. As such, the electrode (bump) **108***a* of the semiconductor element **108** is electrically connected with terminals of the inner lead sections of the wiring pattern **104** in the top-side opening section **106***a*.

In the semiconductor device **100** of Embodiment 1, the top-side opening section **106***a* is slightly larger in a size than the semiconductor element **108**, as shown in FIG. **1**. Specifically, each side of the rectangular shape of the top-side opening section **106***a* is slightly longer in a length than a corresponding side of the rectangular shape of the outer shape of the semiconductor element **108**.

In particular, each side of the rectangular shape of the top-side opening section **106***a* is longer in the length, by a range of not greater than 0.50 mm, than the corresponding side of the rectangular shape of the outer shape of the semiconductor element **108**. With this, a space d**2** between a peripheral part of the top-side opening section **106***a* and a peripheral part of the semiconductor element **108** is set to 0.25 mm or smaller. This is based on the following reason.

However, it is preferable that the size of the top-side opening section **106***a* is set to as small a size as possible, while being maintained to be larger than the size of the semiconductor element **108**. This is because, the larger the size of the top-side opening section **106** is, the larger an area of a line region which is covered with no insulating cover prior to providing of the semiconductor element **108** on the tape base material **102** is. With the line region thus being large in the area, there is an increased risk for a problem such as short-circuit caused by adhesion of an electrically conductive foreign material, or the like.

However, the space d**2** is thus intentionally provided. As such, it is possible that a position mark (of a cross shape, an "L"-like shape, etc.), in accordance with which the semiconductor element **108** is positioned, is provided in the space d**2**. This makes it possible to position the semiconductor element **108** with an increased position accuracy.

Further, because the space d**2** is thus provided, it is also possible to suitably cover a lateral side surface of the semiconductor element **108** with the filling agent **110**. This can set a strength of adhesion of the semiconductor element **108** to a more suitable value.

For the reason, it is preferable that the semiconductor device **100** of Embodiment 1 is arranged such that the space d**2** is provided and is set to a width of up to 0.2 mm. Further, it is preferable that the space d**2** is set to a width of up to 0.25 mm so as to be capable of bearing a common difference of 0.05 mm in the size of the top-side opening section **106***a*.

In the semiconductor device **100** of Embodiment 1, the space d**2** is thus very narrow. That is, the top-side opening section **106***a* is set to as small a size as possible, while being maintained to be larger than the semiconductor element **108**. With this, the semiconductor element **100** of Embodiment 1 can prevent various problems causable if the top-side opening section **106***a* is set to a very large size, such as consumption of more than a required amount of the filling agent **110**, and the like.

The filling agent **110** is fed through a protruding opening section **106***b*, as early described. As such, the narrow width of the space d**2** will not lead to difficulty in feeding of the filling agent, or the like problem.

Protruding Opening Section **106***b*

In Embodiment, the protruding opening section **106***b*, which has a substantially circular shape, is provided in each of the following corner parts (i) and (ii) of the top-side opening section **106***a* in such a manner as to extend locally in an outward direction from a central part of the top-side opening section **106***a*; (i) a corner part which is close to an upper left corner of FIG. **1** and (ii) a corner part which is close to an upper right corner of FIG. **1**. With this, the filling agent **110** can be fed by being fed through the protruding opening section **106***b*, as later described in relation with a manufacturing process.

The semiconductor device **100** of Embodiment 1 is such that a furthest part of the protruding opening section **106***b*, which furthest part is furthest from an end part of a region where the tape base material **102** faces the semiconductor element **108**, is away in an outward direction from the end part of the region by a distance of 0.4 mm to 0.1 mm. This is based on the following reason.

When the filling agent **110** is fed, the dispenser **300** is used so as to discharge the filling agent **110** from a nozzle section **302** into the protruding opening section **106***b* (see FIG. **3**).

Generally, a nozzle section of a dispenser used to feed the filling agent **110** has an inner diameter of about 0.25 mm. The nozzle section **302** of Embodiment 1 is not an exception to this. It follows that an inner diameter of the nozzle section **302** is about 0.25 mm.

Because of this, if the furthest part of the protruding opening section **106***b* is away from the end part of the region by a distance of less than 0.4 mm, then it is difficult to position the nozzle section **302** at a location where the filling agent **110** is fed. Further, if the nozzle section **302** touches the semiconductor element **108**, then the feeding agent **110** cannot be successively fed.

In view, the semiconductor device **100** of Embodiment 1 is such that the distance between the furthest part of the protruding opening section **106***b* and the end part of the region is at least 0.4 mm.

However, if the distance is greater than 1.0 mm, then the area of the line region covered with no insulating component is increased. Consequently, there is an increased risk of having problems such as short-circuit caused by adhesion of an electrically conductive foreign material, disconnection due to an insufficient strength of a line part, and the like.

In view, the semiconductor device **100** of Embodiment 1 is arranged such that the distance between the furthest part of the protruding opening section **106***b* and the end part of the region is 1.0 mm or less.

That is, in the semiconductor device **100** of Embodiment 1, the distance between the furthest part of the protruding opening section **106***b* and the end part of the region is 0.4 mm to 1.0 mm, which is suitable in view of (i) improving of an easiness to feed the filling agent **110** and (ii) preventing the problem caused by the increase in the line region.

However, the distance between the furthest part of the protruding opening section **106***b* and the end part of the region is not limited to 0.4 mm to 1.0 mm. That is, the scope of the present invention does not exclude an aspect that the distance between the furthest part of the protruding opening section **106***b* and the end part of the region is less than 0.4 mm or greater than 1.0 mm.

That is, it is suitable that the protruding opening section **106***b* is such that the space between the protruding opening section **106***b* and the semiconductor element **108** forms a space large enough for the filling agent **110** to be fed.

In the Specification, "an end part of a region where the tape base material **102** faces the semiconductor element **108**" means a part substantially same as a contour of the semiconductor element **108** shown in a top view of the semiconductor device **100** in FIG. **1**.

It is not necessary that the entire nozzle section **302** is located within the protruding opening section **106***b* when the filling agent **110** is fed. It is suitable that 50% or more of the inner diameter of the nozzle section **302** is located within the protruding opening section **106***b*.

Filling Agent **110**

The filling agent **110** is fed, as shown in FIG. **3**, with respect to the semiconductor device **100** shown in FIGS. **1** and **2**. FIG. **3** is a view showing, in an enlarged size, the lateral cross section of the semiconductor device **100** of Embodiment 1 to which the filling agent **110** has been fed.

After providing of the semiconductor element **108** on the tape base material **102**, the filling agent **110** is fed through the top-side opening section **106***a* provided above the tape base material **102**. The filling agent **110** mainly serves to (i) improve the strength of adhesion between the semiconductor element **108** and the tape base material **102**, (ii) protect the surface of the semiconductor element electrode **108***a* of the semiconductor element **108**, (iii) prevent any foreign matter from entering the space between the semiconductor element **108** and the tape base material **102**, and the like.

The electrode **108***a* of the semiconductor element **108** slightly protrudes in a downward direction (i.e., a direction approaching the tape base material **102**) from a main body of the semiconductor element **108**. Because of this, when the semiconductor element **108** is provided, an interface part between the semiconductor element **108** and the tape base material **102** has a very small gap. However, the filling agent **110** which is fed to the top-side opening section **106***a* enters, by capillary action, the gap in the top-side opening section **106***a* and thereby fills the gap.

The filling agent **110** is stemmed by the peripheral part of the top-side opening section **106***a*, i.e., a step caused between the tape base material **102** and the top-side insulating protective film **106**. As such, the filling agent **110** is held along the peripheral part of the top-side opening section **106***a* and kept from easily flowing to an outside of the top-side opening section **106***a*.

In this case, the filling agent **110** coats lateral sides of the semiconductor element **108** in a fillet shape in the space between the top-side opening section **106***a* and the semiconductor element **108**.

The filling agent **110** is made from a material having both flowing and insulating properties. An epoxy resin can be used as the filling agent **110**, for example. It is preferable that the filling agent **110** is made from a material which is thermally or optically curable in reaction to heating or irradiation with ultraviolet light or the like.

A thin film, which is formed by the filling agent **110** and has a thickness of 5 μm to 30 μm, is provided on the top-side insulating protective film **106** in a region (i) surrounding the top-side opening section **106***a* and (ii) outwardly extending from the top-side opening section **106***a* by 2 mm to 3 mm.

A part of the filling agent **110** which has spread in the entire top-side opening section **106***a* overflows, in some cases, the peripheral part of the top-side opening section **106***a* onto a top part of the top-side insulting protective film **106** during a filling-agent feeding process (which is later described). In the semiconductor device **100** of Embodiment 1, this phenomenon is made use of to form such a thin film.

This strengthens a part surrounding the top-side opening section **106***a*, and thereby improves the semiconductor device **100** in tolerance against forces causing disconnection, such as a force applied onto the wiring pattern **104**.

Some of filling agents which are used to seal semiconductor element are shed by top-side insulting protective films, whereas others of the filling agents have an affinity to be spreadable on the top-side insulating protective films. In the semiconductor device **100** of Embodiment 1, the filling agent **110** with affinity to the top-side insulating protective film **106** is used. On this account, even in a case where the filling agent **110** spreads to the top part of the top-side insulating protective film **106**, as described above, the filling agent **110** merely forms the thin film of the thickness of 5 μm to 30 μm. As such, the semiconductor device **100** maintains flexibility as a tape carrier semiconductor device, and is thereby able to be used without any problem.

Reverse-Side Insulating Protective Film **112**

As shown in FIG. **2**, the semiconductor device **100** of Embodiment 1 further includes the reverse-side insulting protective film **112**.

The reverse-side insulating protective film **112** covers a reverse surface of the tape base material **102**. The reverse-side insulating protective film **112** mainly serves to prevent the tape base material **102** from being curled one-sidedly. Further, in a case where electrically conductive members, such as a wiring pattern, a metal terminal, etc., are provided on the reverse surface of the tape base material **102**, the reverse-side insulating protective film **112** also serves to prevent the electrically conductive members from being in contact with each other to be short-circuited, and the like. From this perspective, it is preferable that the reverse-side insulating protective film **112** is, like the top-side insulating protective film **106**, made from an insulating material such as a melamine resin, an epoxy resin, a polyimide resin, or the like.

Further, as shown in FIGS. **1** and **2**, the reverse-side insulating protective film **112** has a reverse-side opening section **112***a* provided on a reverse side below the top-side opening section **106***a*. In Embodiment 1, the reverse-side opening section **112***a* has a shape substantially same as both of the outer shape of the semiconductor element **108** and the outer shape of the top-side opening section **106***a*. Specifically, because both of the outer shape of the semiconductor element **108** and the outer shape of the top-side opening section **106***a* have rectangular shapes (see FIG. **1**), the reverse-side opening section **112***a* has a rectangular shape.

In the semiconductor device **100** of Embodiment 1, the reverse-side insulating protective film **112** having the reverse-side opening section **112***a* is thus provided on the reverse surface of the tape base material **102**. Because both of the insulating protective films provided on the respective top and reverse surfaces of the tape base material **102** are hardened and constricted, it is possible to offset curling caused on the top side of the tape base material **102** with curling caused on the reverse side of the tape base material **102**. This can prevent the table base material **102** from being curled one-sidedly.

In particular, the reverse-side opening section **112***a* is arranged so as to be 1.00 to 8.50 times larger than the region where the semiconductor element **108** faces the reverse-side opening section **112***a*. This is based on the following reason.

Normally, a positioning mark (of a cruciform, an "L" shape, etc.), in accordance with which a semiconductor element is positioned, is marked on a top surface of a tape base material in a space part between a semiconductor element and a peripheral part of a top-side opening section. However, if a reverse surface of a tape base material is covered with a reverse-side insulating protective film on a reverse side below the positioning mark, then there is a problem in positioning of the semiconductor element.

In the semiconductor device **100** of Embodiment 1, the reverse-side opening section **112***a* is at least 1.00 time larger than the region where the semiconductor element **108** faces the reverse-side opening section **112***a*. This can prevent the reverse surface of the tape base material **102** from being covered with the reverse-side insulating protective film **112** on the reverse side below the positioning mark. As such, it is possible to perform the positioning of the semiconductor element **108** without a problem.

Further, the reverse-side opening section **112***a* is set to a size of 8.50 times, at maximum, larger than the region where the semiconductor element **108** faces the tape base material **102**. This enables (i) avoiding interference between a device jig and the reverse-side insulating protective film **112***a* when a reverse side of the semiconductor device **100** is fixed, and (ii) preventing the curling of the tape base material **102**. That is, if the reverse-side opening section **112***a* is set to a size of more than 8.50 times larger than the region, then it is impossible to offset the curling of the tape base material **102** on the top side with curling of the tape base material **102** on the reverse side. Further, in this case, the reverse-side opening section **112***a* becomes equal to or larger than a region punched out by a metal die so as to correspond to an outer shape of the semiconductor element, so that the tape base material **102** is curled after punching.

On this account, it is necessary that the reverse-side opening section **112***a* is set to the size of 1.00 time to 8.50 times larger than the region where the semiconductor element **108** faces the tape base material **102**.

The following describes one example of a process for manufacturing the semiconductor device **100** in accordance with Embodiment 1.

Wiring Pattern Forming Step

First, the wiring pattern **104** is formed on the top surface of the tape base material **102**. The wiring pattern **104** is formed by (i) forming a copper foil on the tape base material **102** by laminating or sputtering and then (ii) performing an etching treatment to the copper foil thus formed.

Top-Side Insulating Protective Film Forming Step

Then, the top-side insulating protective film **106** is formed above the top surface of the tape base material **102** on which the wiring pattern **104** has been formed. In this case, the top-side insulating protective film **106** is formed by applying a material to the above of the top surface of the tape base material **102** except for regions where the inner and outer lead sections of the wiring pattern **104** are formed, in such a manner that the top-side opening section **106***a* is formed in the top-side insulating protective film **106** in the region where the semiconductor element **108** faces the tape base material **102**. Thereafter, the top-side insulating protective film **106** formed above the top surface of the tape base material **102** is cured by a curing treatment suitable for a material of the top-side insulating protective film **106**, such as thermal curing, optical curing, or the like.

Reverse-Side Insulating Protective Film Forming Step

Then, the reverse-side insulating protective film **112** is formed on the reverse surface of the tape base material **102**. In this case, the reverse-side insulating protective film **112** is formed by applying a material to the reverse surface of the tape base material **102** except for a region where the reverse-side opening section **112***a* is formed. Thereafter, the reverse-side insulating protective film **112** thus formed on the reverse surface of the tape base material **102** is cured by a curing treatment suitable for a material of the reverse-side insulating protective film **112**, such as thermal curing, optical curing, or the like.

Semiconductor Element Providing Step

Then, the semiconductor element **108** is provided above the tape base material **102** so that the electrode **108***a* of the semiconductor element **108** is electrically connected with the wiring pattern **104**. In this case, the semiconductor element **108** is positioned in accordance with an alignment mark provided on the tape base material **102**.

A surface of the wiring pattern **104** is covered, with a tin or gold plate, at least in a region where the wiring pattern **104** is electrically connected with the semiconductor element **108**. The wiring pattern **104** thus covered is heated from the reverse surface of the tape base material **102**, and the electrode **108***a* of the semiconductor element **108** is pressed against the wiring pattern **104** thus heated. This fixes, by formation of an eutectic alloy of gold and tin, the electrode **108***a* of the semiconductor element **108** to the corresponding wiring pattern **104** so that they are electrically connected with each other. That is, the semiconductor element **108** is electrically connected with the wiring pattern **104** and fixed to the tape base material **102**.

Filling Agent Feeding Step

Then, the filling agent **110** is fed. The dispenser **300**, which is a conventional and well known dispenser, is used for feeding the filling agent **110**. The dispenser **300** is loaded with a sufficient amount of the filling agent **110** in advance.

When the filling agent **110** is fed, the nozzle section **302** of the dispenser **300** is located, at first, at the given location (e.g., the location P**2** shown in FIG. **1**) within the protruding opening section **106***b*. Then, the filling agent **110** is discharged from the tip of the nozzle section **302** so as to be fed to the inside of the protruding opening section **106***b*.

In Embodiment 1, that part of the protruding opening section **106**, which is furthest from the region where the semiconductor element **108** faces the tape base material **102**, extends from this region by a distance of 0.4 mm to 1.0 mm. As such, when the filling agent **110** is fed, it can be fed through the protruding opening section **106***b*. In this case, because it is only necessary that the nozzle section **302** of the dispenser **300** is located at least within the protruding opening section **106***b*, it is possible to easily perform positioning of the nozzle section **302** of the dispenser **300**. Further, this provides sufficient allowance for an error in positioning of the nozzle section **302** of the dispenser **300**.

The filling agent **110** has fluidity, as early described. As such, when entering the inside of the top-side opening section **106***a* from the protruding opening section **106***b*, the filling agent **110** spreads, by capillary action, in the space between the semiconductor element **108** and the tape base material **102** to the entire top-side opening section **106***a*.

Embodiment 2

Embodiment 2 is described below only as to what is different from Embodiment 1. Therefore, for easy explanation, members having functions like the members employed in Embodiment 1 are given like reference signs, and their explanation is omitted.

FIG. **4** is a view showing a top side of a semiconductor device **100** in accordance with Embodiment 2. The semiconductor device **100** of Embodiment 2 is different from the semiconductor device **100** of Embodiment 1 in that a top-side opening section **106***a* is smaller than a surface of a semiconductor element **108** which surface faces a tape base material **102**.

Specifically, each side of a rectangular shape of the top-side opening section **106***a* is slightly shorter in length than a corresponding side of a rectangular shape of an outer shape of the semiconductor element **108**.

The top-side opening section **106***a* can be set to such a small size that there is no adverse effect on an electric connection between an electrode **108***a* of the semiconductor element **108** and an inner lead section of a wiring pattern **104**.

The top-side opening section **106***a* is thus set to the size smaller than a size of that surface of the semiconductor element **108** which faces the tape base material **102**. With this, the semiconductor device **100** of Embodiment 2 can more securely prevent various problems causable if the top-side opening section **106***a* is set too large, such as consumption of more than a required amount of the filling agent **110**, and the like.

The top-side opening section **106***a* is thus smaller than that surface of the semiconductor element **108** which faces the tape base material **102**. As such, there is no space between a peripheral part of the semiconductor element **108** and a peripheral part of the top-side opening section **106***a*. However, even in the semiconductor device **100** of Embodiment 2, like the semiconductor device **100** of Embodiment 1, the protruding opening section **106***b* outwardly extends from the region where the semiconductor element **108** faces the tape base material **102**. As such, it is still possible to successively feed the filling agent **110** through the protruding opening section **106***b*.

Modification Example

The shape and the location of the top-side opening section **106***a* are not limited to the shapes and the locations described in Embodiments 1 and 2. The top-side opening section **106***a* can have any shape and can be provided at any location, as long as the top-side opening section **106***a* is at least arranged such that the filling agent **110** which is fed to the top-side opening section **106***a* can join the semiconductor element **108** and the tape base material **102** by a suitable strength.

Also, the shape and the location of the protruding opening section **106***b* are not limited to the shapes and the locations described in Embodiments 1 and 2. The protruding opening section **106***b* can have any shape and can be provided at any location, as long as it forms at least a space wide enough for the filling agent **110** to be fed in a region away from the semiconductor element **108**. However, it is preferable that the protruding opening section **106***b* partially has a circular shape, a rectangular shape, a polygonal shape, or another shape each of which has a size large enough for the filling agent **110** to be fed (see the examples in Embodiments 1 and 2).

Modification examples of (i) the top-side opening section **106***a* and (ii) the protruding opening section **106***b* are described below as Embodiment 3.

Embodiment 3

FIG. **5** is a view showing a top side of a semiconductor device **100** in accordance with Embodiment 3. As shown in FIG. **5**, the semiconductor device **100** of Embodiment 3 is same as the semiconductor device **100** of Embodiment 2 in that a protruding opening section **106***b* is provided near an upper left corner part of a semiconductor element **108** which upper left corner part is close to an upper left corner of FIG. **5**. Meanwhile, the semiconductor device **100** of Embodiment 3 is different from the semiconductor device **100** of Embodiment 2 in that a top-side opening section **106***a* is further smaller than the semiconductor element **108**. As such, in the semiconductor element **100** of Embodiment 3, an opening section **106***c* is provided in a top-side insulating protective film **106**, which opening section **106***c* connects the top-side opening section **106***a* with the protruding opening section **106***b* and serves as an inflow path of a filling agent **110**. The semiconductor device **100** of Embodiment 3 are similar to the semiconductor device **100** of Embodiment 2 except this aspect, and the semiconductor device **100** of Embodiment 3 is not described repeatedly here as to what is similar to Embodiment 2.

In the semiconductor device **100** of Embodiment 3, the top-side opening section **106***a* is thus smaller in area than the semiconductor element **108**. With this, the semiconductor device **100** of Embodiment 3 can more securely prevent various problems causable if the top-side opening section is too large, such as consumption of more than a required amount of the filling agent **110** and the like.

Also, although the semiconductor devices **100** of respective Embodiments 3 and 2 are different in view of the shape of the opening section, they are same in that each of them includes the protruding opening section **106***b* which forms a space wide enough for the filling agent **110** to be fed. As such, even in the semiconductor device **100** of Embodiment 3, it is possible that the filling agent **110** is fed at any location within the protruding opening section **106***b* during a feeding process of the filling agent **110**.

In the semiconductor device **100** of Embodiment 3, similarly to the semiconductor device **100** of Embodiment 1, the filling agent **110** is fed into the protruding opening section **106***b*. As such, the small size of the top-side opening section **106***a* does not lead to difficulty in feeding of the filling agent **110**, or the like.

In the semiconductor device **100** of Embodiment 3 shown in FIG. **5**, the top-side opening section **106***a* is thus set to the small size, so that a wiring pattern **102** is covered with a top-side insulating protective film **106** in a region where the electrode **108***a* of the semiconductor element **108** is connected with the wiring pattern **102**. In view of this, the semiconductor element **108** is suitably pressed when being mounted, in such a manner that the electrode **108** penetrates through the top-side insulting protective film **106**. This can realize electric connection between the electrode **108***a* and the wiring pattern **102**, as one or both of them penetrate through the top-side insulating protective film **106**. In the semiconductor device **100** of Embodiment 3, the top-side insulating protective film **106** has a thickness of about 10 μm, whereas the electrode **108***a* has a projection of about 15 μm to 20 μm. As such, it is possible to electrically connect the electrode **108***a* and the wiring pattern **104** in a manner thus described.

Embodiment 4

FIG. **6** is a view showing a top side of a semiconductor device **100** in accordance with Embodiment 4. As shown in FIG. **6**, the semiconductor device **100** of Embodiment 4 is different from the semiconductor device **100** of Embodiment 3 in the following points (i) and (ii), (i) an entire top-side opening section **106***a* has a substantially circular shape and (ii) a part of the top-side opening section **106***a* is provided so as to extend, as a protruding opening section **106***b*, from a central part of a bottom side of the semiconductor element **108** which bottom side is close to a bottom of FIG. **6**. The semiconductor device **100** of Embodiment 4 is similar to the semiconductor device **100** of Embodiment 3 except this aspect, and the semiconductor device **100** of Embodiment 4 is not described repeatedly here as to what is similar to Embodiment 3.

In the semiconductor device **100** of Embodiment 4, the entire top-side opening section **106***a* thus has the substantially circular shape, and the part of the top-side opening section **106***a* is thus provided so as to extend, as the protruding opening section **106***b*, from the central part of the bottom side of the semiconductor element **108**. As such, a size of the entire top-side opening section **106***a* is decreased. With this, the semiconductor device **100** of Embodiment 4 can more securely prevent various problems causable if the top-side opening section **106***a* is too large, such as consumption of more than a required amount of the filling agent **110**, or the like.

Further, the semiconductor device **100** of Embodiment 4 employs the top-side insulting protective film **106** having the opening sections provided in vicinity of a central part of a region where the semiconductor element **108** is provided. This top-side insulating protective film **106** can be employed in various semiconductor devices **100** irrespectively of differences in outer shapes of their semiconductor elements.

Although the semiconductor devices **100** of respective Embodiments 4 and 3 are different in view of the shape of the protruding opening section **106***b*, they are same in that each of them includes the protruding opening section **106***b* which forms a space wide enough for the filling agent **110** to be fed. As such, even in the semiconductor device **100** of Embodiment 4, it is possible that the filling agent **110** is fed at any location within the protruding opening section **106** during a feeding process of the filling agent **110**.

In the semiconductor device **100** of Embodiment 4, similarly to the semiconductor device **100** of Embodiment 3, the filling agent **110** is fed to the protruding opening section **106***b*. As such, the small size of the entire top-side opening section **106***a* does not lead to difficulty in feeding of the filling agent **110**, and the like.

Further, in the semiconductor device **100** of Embodiment 4, like the semiconductor device **100** of Embodiment 3, the top-side opening section **106***a* is thus set to the small size so that the wiring pattern **104** is covered with the top-side insulating protective film **106** in a region where an electrode **108***a* of the semiconductor element **108** is connected with the wiring pattern **104**. As such, in the semiconductor device **100** of Embodiment 4, the semiconductor element **108** is suitably pressed when being mounted, so that the electrode **108***a* penetrates through the top-side insulting protective film **106**. This can electrically connect the electrode **108***a* with the wiring pattern **104**, as one or both of the electrode **108***a* and the wiring pattern **104** penetrate through the top-side insulating protective film **106**. In the semiconductor device **100** of Embodiment 4, the top-side insulting protective film **106** has a thickness of about 10 μm, whereas the electrode **108***a* has a protrusion of about 15 μm to 20 μm. As such, it is possible to electrically connect the electrode **108***a* and the wiring pattern **104** in a manner thus described.

The present invention is not limited to the description of each of Embodiments 1 through 4, but may be altered by a skilled person in the art within the scope of the claims. That is, an embodiment derived from a proper combination of technical means altered within the scope of the claims is also encompassed in the technical scope of the present invention.

SUMMARY

As described above, a semiconductor device of the present invention is a tape carrier semiconductor device including a semiconductor element provided on a top surface of a tape base material so as to be electrically connected with a wiring pattern provided on the top surface of the tape base material, the semiconductor device of the present invention including: a top-side insulating protective film covering the top surface of the tape base material; and a reverse-side insulating protective film covering a reverse surface of the tape base material, the top-side insulating protective film having (i) a top-side opening section opening in at least a part of a region where the top surface of the tape base material faces the semiconductor element and (ii) a protruding opening section outwardly extending from the region, the reverse-side insulating protective film having a reverse-side opening section opening on a reverse side below the top-side opening section, an opening of the reverse-side opening section being 1.00 time to 8.50 time larger in an area than the region where the top surface of the tape base material faces the semiconductor element, and a filling agent filling a gap between the semiconductor element and the tape base material in the region where the top surface of the tape base material faces the semiconductor element.

With the arrangement, the insulating protective films shrink on the respective top and reverse sides of the tape base material when the insulating protective films are cured. As such, it is possible to offset curing caused on a top surface side of the tape base material with curling caused on a reverse surface side of the tape base material. This is very advantageous to manufacturing of the tape carrier semiconductor device. That is, according to the manufacturing of the tape carrier semiconductor device, (i) the semiconductor element is mounted, after formation of the insulating protective films, in the top-side opening section (the inner lead section) covered with no insulating protective film, and then (ii) the filling agent is fed in between the semiconductor element and the top-side opening section. That is, in order to provide the top-side opening section which is necessary for mounting of the semiconductor element, it is necessary to prevent the tape base material from being curled in a region where the top-side opening section is provided. However, if the insulating protective film is formed on the entire reverse surface of the tape base material without having the top-side opening section, then the tape base material is curled one-sidedly in the top-side opening section. In view of this, the reverse-side opening sections are provided in the arrangement, so as to enable avoiding such a situation. Therefore, it is possible that the filling agent is suitably fed to the entire space between the semiconductor element and the tape base material.

Further, the positioning mark (of a cruciform, an L-shaped form, etc.) in accordance with which the semiconductor element is positioned is provided on the top surface of the tape base material in the space part between the semiconductor element and the peripheral part of the top-side opening section. However, if the reverse surface of the tape base material is covered with the reverse insulting protective film in a region on the reverse side below the positioning mark, then a problem is caused to positioning of the semiconductor element. As a countermeasure to this, it is arranged such that the opening of the reverse-side opening section is set to a size at least 1.00 time larger than the area of the region where the top surface of the tape base material faces the semiconductor element. Because this enables avoiding a risk that the reverse surface of the tape base material is covered with the reverse-side insulating protective film in the region on the reverse side below the positioning mark, it is possible to perform the positioning of the semiconductor element without any problem.

Also, because the opening of the reverse-side opening section is thus 1.00 time to 8.50 times larger in the area than the region where the tape base material faces the semiconductor element, it is possible to (i) avoid interference that, when a reverse side of the semiconductor device is fixed, a device jig and the reverse-side insulating protective film interfere with each other and (ii) prevent the curling of the tape base material.

It is preferable that the semiconductor device of the present invention is, further to being arranged as above, arranged such that: the semiconductor element and the top-side opening section have respective rectangular shapes; and each side of the rectangular shape of the top-side opening section is shorter in a length than a combined length of (i) a length of a corresponding side of the rectangular shape of the semiconductor element and (ii) a length of 0.50 mm.

The arrangement enables preventing various problems causable if the opening of the top-side opening section is too large, such as consumption of more than required amount of the filling agent, etc., as compared with an arrangement that each side of the rectangular shape of the top-side opening section is longer in the length than the corresponding side of the rectangular shape of the semiconductor element by a length of 0.5 mm or longer.

Further, it is preferable that the semiconductor device of the present invention is, further to being arranged as early described, arranged such that the protruding opening section outwardly extends, by 0.4 mm to 1.0 mm, from an end part of the region where the top surface of the tape base material faces the semiconductor element.

With the arrangement, the filling agent can be fed in any location within the protruding opening section during a feeding process. This enables easily positioning the dispenser which feeds the filling agent, or the like. Further, even if the dispenser for feeding the filling agent, etc. is located at a position different from an intended one, it is possible to bear such a positioning error.

Further, it is preferable that the semiconductor device of the present invention is, further to being arranged as early described, arranged such that: the wiring pattern has an extending section provided in the top-side opening section provided on a top surface side of the tape base material; and the extending section has a width of 0.05 mm to 0.20 mm and extends from a connection part of the wiring pattern and the semiconductor element toward a center part of the top-side opening section.

With the arrangement, the filling agent which is fed to the inside of the top-side opening section in a liquid form flows, by surface tension, along the extending section to an inner part of the top-side opening section in the gap between the semiconductor element and the tape base material. As such, it can be easy to feed the filling agent to the inner part of the top-side opening section in the gap between the semiconductor element and the tape base material. In particular, because the extending section is set to the line width of 0.05 mm to 0.20 mm, it is possible to (i) prevent the extending section from being burned and (ii) make it difficult for the filling agent to be exfoliated.

Further, it is preferable that the semiconductor device of the present invention is arranged such that a thin film having a thickness of 5 μm to 30 μm being provided on that part of the top-side insulating protective film which (a) surrounds the top-side opening section and (b) extends from an end part of the top-side opening section by 2 mm to 3 mm.

With the arrangement, because the region surrounding the top-side opening section can be thus strengthened, it is possible to improve the semiconductor device in tolerance of the wiring pattern against forces causing disconnection thereof, such as a force applied to the wiring pattern. Further, because the thickness of the thin film is merely about 5 μm to 30 μm, a flexibility of the tape carrier semiconductor element can be maintained, thereby causing no problem when being used.

A method of the present invention for manufacturing a semiconductor element is a method for manufacturing a tape carrier semiconductor device including a semiconductor element provided on a top surface of a tape base material so as to be electrically connected with a wiring pattern provided on the top surface of the tape base material, the method including the steps of: forming a top-side insulating protective film covering the top surface of the tape base material, wherein the step of forming the top-side insulating protective film forms the top-side insulating protective film which has (i) a top-side opening section opening in at least a part of a region where the top surface of the tape base material faces the semiconductor element and (ii) a protruding opening section outwardly extending from the region; and forming a reverse-side insulating protective film covering a reverse surface of the tape base material, wherein the step of forming the reverse insulting protective film forms the reverse-side insulating protective film which has a reverse-side opening section opening in a reverse side of the top-side opening section, an opening of the reverse-side opening section being 1.00 time to 8.50 times larger in an area than the region where the top surface of the tape base material faces the semiconductor element; and feeding a filling agent through the protruding opening section to the region where the top surface of the tape base material faces the semiconductor element.

The arrangement can bring about, in manufacturing of the semiconductor device, an effect similar to the effect bought about by the semiconductor device of the present invention early described.

INDUSTRIAL APPLICABILITY

A semiconductor device of the present invention and a method of the present invention for manufacturing a semiconductor device can be applied to various semiconductor devices and various methods for manufacturing semiconductor devices, respectively, each of which (i) and (ii) employs an art of sealing, with a filling agent, an electronic component provided on a tape base material.

REFERENCE SIGNS LIST

100: semiconductor device
102: tape base material
104: wiring pattern
106: top-side insulating protective film
106*a*: top-side opening section
106*b*: protruding opening section
108: semiconductor element
108*a*: electrode
110: filling agent
112: reverse-side insulating protective film
112*a*: reverse-side opening section

The invention claimed is:

1. A semiconductor device, which is a tape carrier semiconductor device including a semiconductor element provided on a top surface of a tape base material so as to be electrically connected with a wiring pattern provided on the top surface of the tape base material, the semiconductor device comprising:

a top-side insulating protective film covering the top surface of the tape base material; and

a reverse-side insulating protective film covering a reverse surface of the tape base material,

the top-side insulating protective film having (i) a top-side opening section opening in at least a part of a region where the top surface of the tape base material faces the semiconductor element and (ii) a protruding opening section outwardly extending from the region,

the reverse-side insulating protective film having a reverse-side opening section opening on a reverse side below the top-side opening section,

an opening of the reverse-side opening section being more than 1.00 time to not more than 8.50 times larger in an area than the region where the top surface of the tape base material faces the semiconductor element, and

a filling agent filling a gap between the semiconductor element and the tape base material in the region where the top surface of the tape base material faces the semiconductor element.

2. The semiconductor device as set forth in claim **1**, wherein:

the semiconductor element and the top-side opening section have respective rectangular shapes; and

each side of the rectangular shape of the top-side opening section is shorter in a length than a combined length of (i) a length of a corresponding side of the rectangular shape of the semiconductor element and (ii) a length of 0.50 mm.

3. The semiconductor device as set forth in claim **1**, wherein

the protruding opening section outwardly extends, by 0.4 mm to 1.0 mm, from an end part of the region where the top surface of the tape base material faces the semiconductor element.

4. The semiconductor device as set forth in claim **1**, wherein:

the wiring pattern has an extending section provided in the top-side opening section provided on a top surface side of the tape base material; and

the extending section has a width of 0.05 mm to 0.20 mm and extends from a connection part of the wiring pattern and the semiconductor element toward a center part of the top-side opening section.

5. The semiconductor device as set forth in claim **1**, comprising:

a thin film having a thickness of 5 μm to 30 μm being provided on that part of the top-side insulating protective film which (a) surrounds the top-side opening section and (b) extends from an end part of the top-side opening section by 2 mm to 3 mm.

6. The semiconductor device as set forth in claim **1**, wherein the protruding section has a substantially circular shape and is provided at at least one corner part of the top-side opening section.

7. The semiconductor device as set forth in claim **1**, wherein the wiring pattern includes an extending section which extends inwardly from a region to which an electrode of the semiconductor element is located to a substantially center region of the top-side opening section.

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